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(54) **Brake booster providing vehicular hill holder.**

(57) A brake booster (10, 210, 310) connected to a control circuit (120) provides for continued braking of a vehicle when the vehicle is situated on an incline and the brake pedal (92) is released by the operator. Continued brake application is accomplished by utilizing a control circuit (120) responsive to vehicular attitude, clutch pedal position, ignition status, vehicular speed, and vehicular direction. The control circuit (120) is connected to a combination check valve and three-way solenoid valve (100, 200, 300) connected to a movable wall brake booster (10, 210, 310). The combination valve (100) is connected to a flexible hose (110) disposed interiorily of the booster (10), the other end of the flexible hose (110) connected to the input opening (32) of a three-way poppet valve (70) located at the central hub (30) of the booster (10). When the control circuit (120) senses that the vehicle is on an incline, the clutch pedal depressed, the ignition "on", the speed is zero, and the vehicle not backing up, it actuates the three-way solenoid of valve (100) which continues to supply a first fluid pressure to the front booster chamber (40) while supplying a second fluid pressure for the rear booster chamber (50) via the flexible hose (110) and poppet valve 170. The vehicle operator may release the brake pedal (92) which returns slightly toward an inactive position and which opens slightly valve (70), with the brakes remaining activated because the second fluid pressure is provided to the rear chamber (50) via the hose connection (110) and valve (70) to maintain the axially displaced position of the movable wall (24).

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BRAKE BOOSTER PROVIDING VEHICULAR HILL HOLDER

The present invention relates to a vehicular hill holder system which includes a control circuit and a booster operable by either vacuum pressure or compressed air.

Car manufacturers are attempting to provide an economical solution for a long-standing problem with manual shift vehicles: how to permit the vehicle operator to manipulate the clutch pedal, brake pedal, accelerator pedal, and shift the gear lever when the vehicle is stationary on an incline. Such inclines are common at railroad crossings and in rural and metropolitan areas.

A solution to this problem is provided by mechanical roll-back lock devices that effect the mechanical lockup of the brake pedal through mechanical mechanisms connected to the brake and clutch pedals. However, such devices occupy additional cab space and require assembly and installation costs that are an add-on to the vehicle cost.

It is an object of the present invention to provide an inexpensive, practical vehicular hill holder system brake booster which utilizes presently existing equipment on manual shift vehicles. It is desirable that such a system may be included as either optional or original equipment on a manual shift vehicle, without requiring significant modification of the vehicle's equipment or any significant increase in cost.

The present invention comprises a vehicular hill holder system which utilizes presently existing booster equipment. A brake booster constructed in accordance with the present invention is connected to a control circuit which provides for continued braking of a vehicle when the vehicle is situated on an incline and the brake pedal released by the vehicle operator. Continued braking of the vehicle is accomplished by a control circuit responsive to vehicular attitude, clutch position, ignition status, vehicular speed, and vehicular direction. The control circuit is connected to the combination of a

or servomotors utilized in the present invention may take many different forms of conventional brake boosters being manufactured today. Only slight modification is required in order for a booster unit to be used in the present invention, and almost any conventional vacuum or compressed air booster unit may be utilized. Thus, the brake booster vehicular hill holder provides a low-cost, inexpensively manufactured unit because many of the present-day brake booster units may be utilized.

The booster 10 comprises a front shell 12 and a rear shell 14 which are attached together at rim portion 16. A master cylinder (not shown) would be attached to the booster 10, and provide an actuating means for operating the brakes of the vehicle when the master cylinder is actuated by the actuating rod 18. The front and rear shells 12, 14 are attached together at connection section 16 so as to trap the external bead 20 of the flexible diaphragm 22. Flexible diaphragm 22 is secured to movable wall 24 within the interior of the servomotor or booster unit 10. Diaphragm 22 terminates radially inwardly in an internal bead 26 received within a groove 28 of the central hub 30.

Diaphragm 22 of movable wall 24 divides booster unit 10 into a front chamber 40 and a rear chamber 50. Disposed within front chamber 40 is a return spring 42 having one end mounted against front shell 12 and the other end engaging the central hub 30. Central hub 30 includes a first passage 32 which, in conventional booster units, provides communication between front chamber 40 and internal bore 60. Central hub 30 also includes a body portion 34 which extends rearwardly to form the rearward projection 36 and bore 61. Bore 60 extends toward rearward projection 36, and disposed in bore 60 is a standard poppet valve 70. Body portion 34 includes a second passage 33 providing communication between rear chamber 50 and bore 60. Valve 70 comprises a conventional and well-known poppet valve structure utilized in many different booster embodiments and applications.

how a booster unit may be modified in order to operate in accordance with the present invention, are illustrated in Figures 3 and 4, which will be described in detail.

Referring to Figure 2, there is illustrated a control circuit 120 utilized with the present invention. The vehicle's battery 124 is connected to ignition switch 126 coupled by wire 127 to clutch pedal switch 128. Clutch pedal switch 128 provides an output in accordance with the position of the clutch. If the clutch pedal is depressed or "in", such that the vehicle is not in gear, then clutch pedal switch 128 provides an output through line 133 connected in series with a vehicle attitude switch 140. However, if the clutch pedal is released such that the vehicle may be "in gear" or in neutral, then clutch pedal switch 128 provides an electrical output through line 136 to the "in gear" switch 150. Vehicle attitude switch 140 may comprise any type of conventional mercury level switch or other device which will provide a switch closure when the vehicle is situated at a predetermined angle. Line 142 connects attitude switch 140 with the zero speed sensor 160. Vehicle zero speed sensor 160 comprises a sensor which receives inputs indicative of the vehicle's direction of movement and whether or not the vehicle is moving or stationary. The vehicle's back-up light switch 170 provides an electrical output through line 172 so that if the vehicle is backing up, a signal is relayed via line 172 to zero speed sensor 160 whereby an operative output signal is not effected by the sensor 160. In other words, back-up light switch 170 provides a "defeat" instruction to zero speed sensor 160. A cruise control transducer 166 normally utilized in conjunction with the speedometer cable of a vehicle, provides an indication of whether or not the vehicle is moving. Cruise control transducer 166 provides a pulse output to the vehicle's cruise control device (not shown), and it is the pulse output which is used also as an output signal through line 144 to zero speed sensor 160. When an electrical pulse output from

system finds use in cities that are very hilly, rural areas, and at railroad track crossings which typically include inclines. Many vehicle operators have experienced difficulty in keeping a manual shift vehicle from rolling backwards on an incline, because of the necessary simultaneous operation of the clutch pedal, brake pedal, shifting of the gear lever, and operation of the accelerator pedal when the operator is ready to accelerate the vehicle. The present invention provides a practical solution to this problem by providing a vehicular hill holder for manual shift vehicles which have brake booster units. The brake booster units may be either conventional vacuum brake boosters or conventional compressed air brake boosters, both types being easily modified for use in the present invention.

OPERATION

The extension 103 of combination valve 100 is coupled to the engine's intake manifold. Vacuum is provided to the valve 100 which communicates the vacuum via circumferential passages 106 to the front chamber 40 of booster 10, and via input connection 104 to conduit 110 and passage 32 in central hub 30. Passage 32 communicates vacuum through second valve seat 74 to central bore 60 and through second passage 33 to rear chamber 50. When the vehicle's operator depresses brake pedal 92, input rod 90 is displaced such that second valve seat 74 is closed and vacuum no longer communicated to chamber 50 via passage 32, central bore 60, and second passage 33. Further displacement of rod 90 opens first valve seat 72 so that atmosphere may enter rear chamber 50. Atmosphere enters rear chamber 50 through rear opening 82, filter 84, bore 61, open first valve seat 72, bore 60, and passage 33. The introduction of atmospheric pressure into rear chamber 50 and the continued provision of vacuum within front chamber 40 effects a displacement of movable wall 24 which displaces actuating rod 18 to operate the master cylinder (not shown) and effect braking of the vehicle. So far, operation of the brake

central bore 60, passage 33, and rear chamber 50. In a conventional booster unit, at this point in operation, vacuum pressure would have been communicated via passage 32 to central bore 60, second passage 33, and rear chamber 50 in order to effect the return of movable wall 24. However, in this case atmospheric pressure continues to be provided to rear chamber 50 via passage 32, slightly open second valve seat 74, central bore 60, and second passage 33. The brakes of the vehicle remain activated, allowing the operator to remove completely his foot from the brake pedal. The continued supply of atmospheric pressure, or in the case of compressed air vacuum boosters, a second higher fluid pressure, to the rear chamber ensures that movable wall 24 remains in its activated position which effects continued actuation of the master cylinder and braking of the vehicle.

Referring again to Figure 2, when the vehicular operator decides to accelerate the vehicle by shifting the gear lever, releasing the clutch pedal and depressing the accelerator pedal, the release of the clutch pedal opens clutch pedal switch 128 to terminate the electrical signal communicated through lines 133, 142, 176, and 101 to three-way solenoid valve of combination valve 100. The opening of this portion of circuit 120 permits the solenoid valve to return to its initial inactive position wherein vacuum is communicated again via connection 104, hose 110, passage 32, slightly open second valve seat 74, and central bore 60 to second passage 33 and rear chamber 50. Thus, deactivation of the three-way solenoid valve operatively effects deactivation of the brakes as movable wall 24 returns toward its initial at-rest position. The cessation of the supply of atmospheric pressure to rear chamber 50 permits movable wall 24 to retract under the force of spring 42, toward an inactive position which results in a full return of poppet valve 70 to the position illustrated in Figure 1.

As follows from the detailed description above, the present invention provides a vehicular hill holder

to pass through line 179 to time delay relay 190. Time delay relay 190 delays operation of its switch contacts and the actuation of mechanical connections 192 and 193 for a period of approximately ten seconds. Once ten seconds have elapsed, mechanical connections 192 and 193 are actuated so that normally closed time delay switch 177 is opened and normally open time delay switch 194 is closed. Thus, should the vehicle operator decide to shift gears and depress the clutch pedal inwardly, an electrical output through line 133, vehicle attitude switch 140, line 142, zero speed sensor 160 and line 176 would not reach combination valve 100 and cause operation thereof. Likewise, time delay switch 194 is closed so that the warning light 199 is activated and the vehicle operator made aware of a failure in the circuit, and a signal provided through line 198 to keep relay 190 energized and switch 177 open.

If the vehicle is parked and the operator has turned on the ignition switch, depressed the clutch, and is utilizing the hill holder, operation of the hill holder will be permitted for an unlimited period of time or until the vehicle operator releases the clutch pedal in order to place the vehicle in gear. Here the hill holder system is operating at a stationary position of the vehicle when the speedometer cable is broken, whereby the vehicle operator may use the hill holder system for an unlimited period of time or until the clutch pedal is released to place the vehicle in gear. At that time, an electrical signal would pass from the now closed "in gear" switch 150 via line 178 through the zero speed switch 180 and line 179 to time delay relay 190. After a time delay period of approximately ten seconds, the contacts of mechanically connected switches 194 and 177 would transfer. Switch 177 would open to render the hill holder system inoperative. Switch 194 has a dual function wherein (1) a signal from line 196 passes along line 197 to energize warning light 199, and (2) a signal passes along line 198 to provide a latching signal to

wall 224 and rear shell 214. Thus, when the vehicle operator removes his foot from the brake pedal, even though valve seat 272 closes and valve seat 274 opens slightly, bladder 208 remains inflated and maintains the displaced position of movable wall 224 to continue braking of the vehicle. Upon release of the clutch pedal by the vehicle operator, control circuit 120 would deactivate valve 200 which again supplies vacuum to bladder 208 to deflate it and allow movable wall 224 to return to an inactive position.

Referring to Figure 4, a third embodiment of the brake booster unit is illustrated. A booster unit 310 includes a flexible bellows 410 at the central area thereof, one end 411 of the bellows being connected to the front shell 312 and the other end 412 connected to movable wall 324. Check valve connection 304 enables vacuum to be continuously communicated to front chamber 340, and connection 306 provides for communication of vacuum to the interior of bellows 410. The valve 300 (three-way solenoid valve) is coupled to previously described control circuit 120 so that when the control circuit operates in accordance with the above-described conditions, an electrical signal to combination valve 300 effects operation of the threeway solenoid valve contained therein. Operation of valve 300 terminates the communication of vacuum via connection 306 to the interior of bellows 410 and permits atmosphere to be communicated through connection 306, bellows 410, first passage 332, slightly open second valve seat 374, and interior bore 360 to second passage 333 and rear chamber 350. Thus, booster unit 310 operates in the same manner as the booster unit illustrated in Figure 1, although unit 310 utilizes a bellows 410 to provide an alternative means for communicating vacuum or atmosphere to first passage 332 and poppet valve 370.

Although this invention has been described in connection with the illustrated embodiments, it will be obvious to those skilled in the art that various changes

BRAKE BOOSTER PROVIDING VEHICULAR HILL HOLDER

CLAIMS

1. A braking assistance servo motor (10, 310) comprising a casing (12, 14; 312, 314), an assistance piston assembly (24, 324) displaceable in the casing and dividing the casing into first (40, 340) and second (50, 350) chambers, an input member (90, 390), an output member (18, 318) actuable by the piston assembly, and first valve means (70, 370) providing selective communication with said chambers, characterized in that the servo motor (10, 310) includes means (100, 110; 300, 410) for maintaining a braking position of said piston assembly (24, 324), the piston assembly braking position maintenance means comprising the combination of second valve means (100, 300) and means for connecting (110, 410) said second valve means (100, 300) with said first valve means (70, 370), said second valve means (100, 300) providing a first fluid pressure to the second chamber (50, 350) via the connection means (110, 410) and first valve means (40, 340), actuation of said first valve means (70, 370) terminating the supply of said first fluid pressure to the second chamber (50, 350) and providing a second fluid pressure to said second chamber (50, 350) in order to displace said assistance piston assembly (24, 324) and output member (18, 318), the second valve means (100, 300) being actuable to provide said second fluid pressure to said connection means (110, 410), first valve means (70, 370), and second chamber (50, 350) in order to maintain the displaced position of said assistance piston assembly (24, 324) when said first valve means (70, 370) is deactuated.

2. The braking assistance servo motor (10, 310) in accordance with claim 1, characterized in that said second valve means (100, 300) comprises the combination of a check valve and a threeway solenoid valve.

3. The braking assistance servo motor (10, 310) in accordance with claim 1, characterized in that the

such that the device (208) expands against said movable wall (224) and maintains the displaced position of the wall (224) when said brake pedal is released and deactuates said valve (270).

8. The vehicle brake booster (210) in accordance with claim 7, characterized in that said inflatable device (208) has an outlet (202) extending through an opening in the casing (214) of said booster, the outlet (202) connected to said control valve means (200).

9. The vehicle brake booster (210) in accordance with claim 7, characterized in that said inflatable device (208) comprises an inflatable bladder (208) disposed in the rear working chamber (250) between the movable wall (224) and the casing (214), the bladder (208) receiving said first fluid pressure from said control valve means (200) prior to actuation of said control valve means (200).

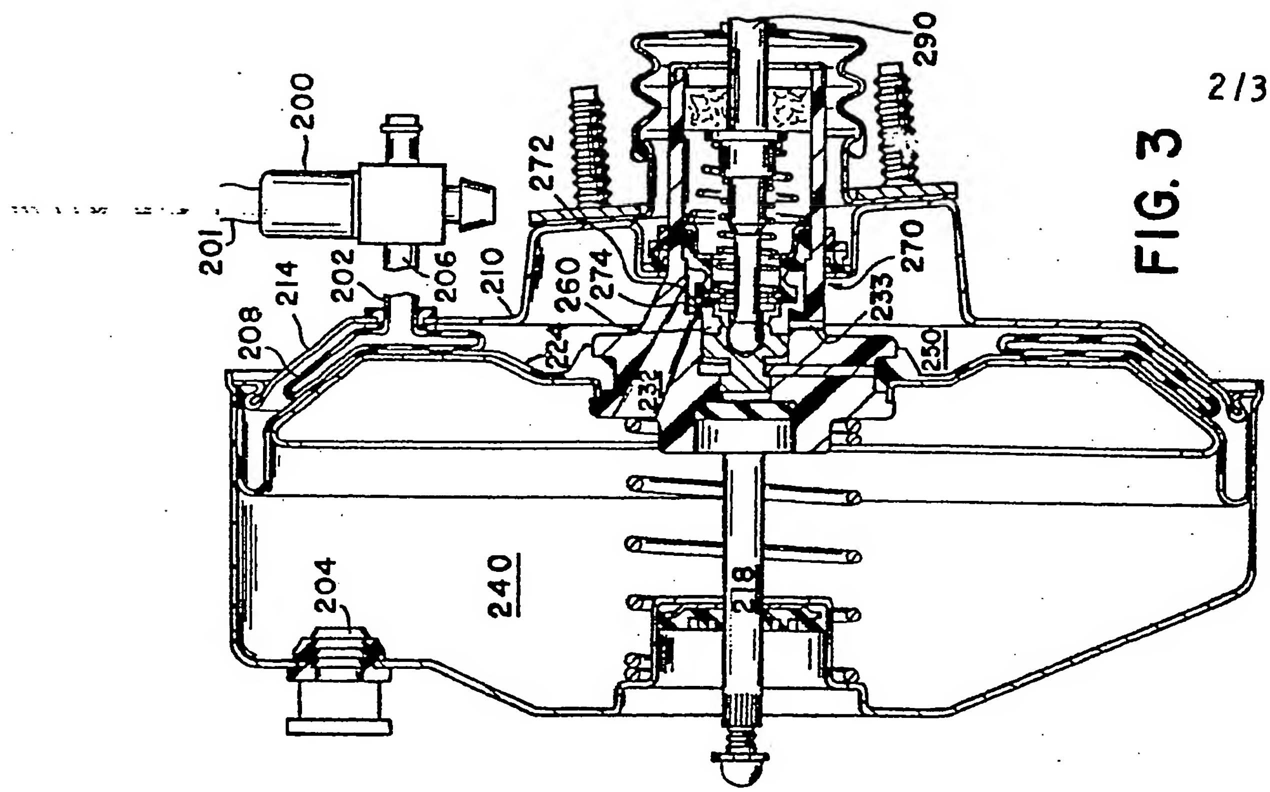
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FIG. 3

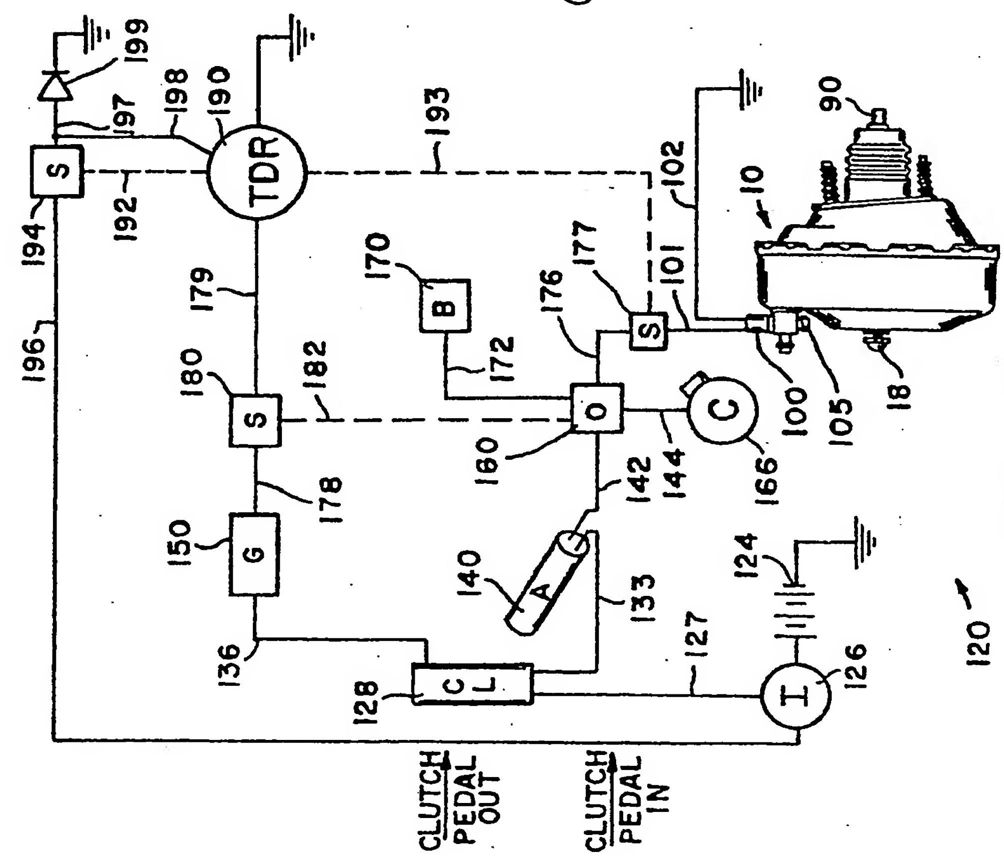
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FIG. 2

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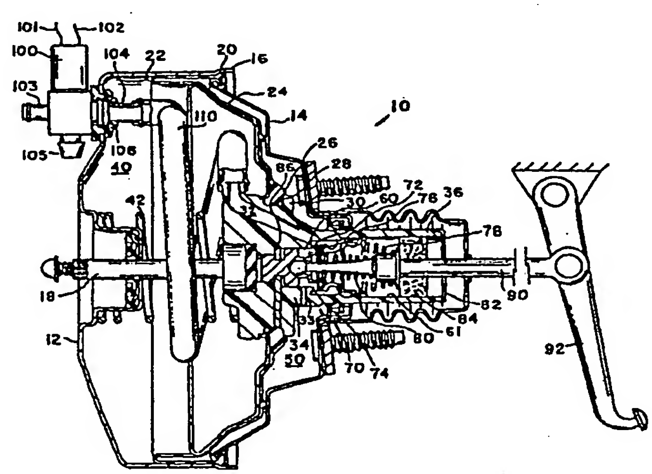

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